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NOISE AND SONIC BOOM IMPACT TECHNOLOGY

PCBOOM Computer Program for Sonic Boom Research: Technical Report

Volume I of III Volumes

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Noise and Sonic Boom Impact Technology Program
Human Systems Division
Air Force Systems Command
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This technical report has been reviewed and is approved for publication.

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The PCBOOM computer program, described in this technical report, calculates the location and magnitude of sonic boom overpressures on the ground due to supersonic flight under standard atmosphere and no wind propagation conditions. The program is intended for environmental planners and engineers who may need to estimate the noise impact from individual flights of supersonic military aircraft. The program runs on a Zenith Z-248 personal computer and also should run on most similarly configured IBM-compatible computers. The program contains information for all current military aircraft and allows updating for additional aircraft. The user can select either "quick look" computations which assume steady-state flight or detailed ray-tracing calculations which can handle non-steady flight and sonic boom focus conditions. Several types of simple maneuvers can be selected for computations; the program will also handle up to ten connected straight line segments. Flight segments from the MOAOPS library of supersonic combat training flights may also be selected. User-specified output for printer, plotter or screen includes tables of overpressures and graphic display of the sonic boom overpressure "footprints" on the ground. The footprint plots show the (continued)

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19. (continued)

location of all ray positions which exceed overpressures of a given level. Flight track, Mach number and altitude profile plots are also provided.

This report summarizes the technical basis for PCBOOM. Two other reports provide a program users/computer operations manual and a program maintenance manual.

ACKNOWLEDGMENTS

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1. GENERAL

1.1 Purpose

This manual contains the information for both the user and for computer operations. This manual will provide the user's non-Automated Data Processing (ADP) personnel with the information necessary to effectively use the system. In addition, it provides the computer operation personnel with a detailed operational description of the computer system and its associated environment.

1.2 Program History and Overview

The major purpose of the PCBOOM program is to provide the user a means of predicting the location and magnitude of sonic boom overpressures on the ground in the vicinity of supersonic flights. The user can select two different types of calculations. The first method uses the simplifying assumptions developed by Mr. Harry W. Carlson (Reference 1). This method runs very quickly, but does not account for any focusing.

The second method uses ray tracing techniques to more accurately approximate the overpressure from supersonic flights. This method also estimates the overpressure due to focusing. The ray tracing routines were adapted from the BOOMAP2 program developed for mainframe computers (References 2, 3, 4).

All inputs to the program are entered from user-friendly interactive screens. After selecting the method to be used, the user is given a choice of selecting a single flight track from the MOAOPS Library (Reference 5), or entering the necessary operational information through the computer screens.

The user may select several forms of output. These include:

1. Plot of flight track generated from user inputs.
2. Plot of mach number profile from user inputs.
3. Plot of altitude profile from user inputs.
4. Sideline plot of the overpressure versus distance for a single flight track point (Carlson's Method only).
5. Tabular output of overpressure versus sideline distance for a single flight track point (Carlson's Method only).
6. Contour plot of overpressure. The user may choose between two measures of boom strength: the C-weighted sound exposure level (CSEL) in dB, or the maximum overpressure in pounds per square foot (psf).

1.3 Terms and Abbreviations

In this report, overpressure will typically mean the magnitude of the sonic boom at a given point expressed in terms of the maximum overpressure in pounds per square foot (psf), or in terms of the overall sound pressure level in dB.

2. SYSTEM SUMMARY

2.1 Hardware

PCBOOM has been developed to run on a Zenith Z-248 personal computer running under MS DOS Version 3.0 or greater, with at least a 10 megabyte hard disk, 640K RAM, and an 8087 math co-processor. The computer should be booted up with the "FILES." command in "CONFIG.SYS" set to at least 20. It should also run on most IBM compatible computers similarly configured. The software runs best with an enhanced graphics adapter card (EGA), or a color graphics adapter card (CGA). A Hercules graphics card may be used, but the plots are not as distinct and the input screens are not as easy to use.

The program is compatible with a wide variety of output devices. These are listed in Table 1.

2.2 Software

All programs developed for this project were written in ANSI 77 FORTRAN. They were compiled using Microsoft Version 4.0 software (Reference 6). Two commercially available software packages were also used. The SPINDRIFT libraries were executed to provide user-friendly input screens (Reference 7). PLOT88 routines were incorporated to provide both X-Y plots and contour plots (Reference 8).

2.3 Resources

The computer program uses approximately 610K of computer memory. If the message "Program too big for RAM" appears, it will be necessary for the user to re-boot the computer with the minimum operating system. Because of the memory constraint, each execution of PCBOOM is limited to 98 flight track points.

The amount of execution time varies depending upon the type of inputs selected. When using Carlson's Method, most runs execute in 1-2 minutes without contour plotting and in 4-7 minutes with contour plots. With ray tracing, the execution times can be between 45 minutes and 48 hours. An estimate of the amount of time required is printed on the screen prior to execution of a ray tracing run so that the user can decide whether to proceed with the job.

All outputs are designed to be displayed on the computer's monitor, or printed or plotted on 8-1/2" by 11" paper. The number of pages of output depends on the options selected.

2.4 Databases

It is possible to select single flights from the MOAOPS library. Libraries are provided for Holloman, Luke, Nellis, and Tyndall Air Force Bases. Each library is provided on a separate diskette. Care must be used in selecting a flight from these libraries. Many of the segments contain no supersonic flight points, even though they are found in the database. This inconsistency occurs because the selection of segments for the library was based upon their reported air speed, not their ground speed. If there is not at least one valid point, neither method will work. Three valid points within 4.4 seconds of each other are required for the ray trace method.

Table 1. Output Devices Supported.

EPSON FX-80
EPSON FX-80+
EPSON JX-80
EPSON FX-85
EPSON FX-185
EPSON FX-286
EPSON MX-80
EPSON RX-80
EPSON FX-100
EPSON FX-100+
EPSON MX-100
EPSON LQ-1500

IBM GRAPHICS PRINTER
IBM PROPRINTER

CENTRONICS GLP

OKIDATA 92
OKIDATA 93
OKIDATA 182
OKIDATA 192
OKIDATA 193

HI DMP-51
HI DMP-52
HI DMP-56A

ENTER SP-600
ENTER SP1000
ENTER SP1200

IOLINE LP3700

HP 7440A
HP 7470A
HP 7475A
HP 7550A
HP 7570A
HP 7580B
HP 7585B
HP 7586B
HP 7595A
HP 7596A
HP THINKJET (2225A)
HP QUIETJET (2228A)
HP QUIETJET PLUS (2227A)
HP LASERJET PRINTERS

TEKTRONIX 4025

HERCULES GRAPHICS CARD

IBM EGA
IBM COLOR GRAPHICS ADAPTER

3. PROGRAM EXECUTION REQUIREMENTS

3.1 Getting Started

PCBOOM is delivered on six diskettes. Two of these diskettes contain the files necessary to execute the program. The directories for these two disks are given in Tables 2 and 3. The other four diskettes contain the four MOAOPS databases, one each for Holloman, Luke, Nellis, and Tyndall Air Force Bases. Each of these four disks has two files labeled 'LIBRY' and 'INDEX'.

To install the software, it is best to open a new directory named PCBOOM on the hard disk by using the following DOS commands:

```
MD PCBOOM
CD PCBOOM
```

It is then necessary to copy the program files to this new directory: Place the first program disk into floppy drive A. Type the following:

```
COPY A:*.*
```

Then, place the second disk into drive A and repeat the procedure.

After installation, the program can be executed by changing directories to PCBOOM and at the prompt, typing "PCBOOM".

3.2 Input Specifications

All inputs are prompted from a series of "Screens". The flow between screens is shown in Figure 1. Each of the 18 screens is identified in Figure 1. For each screen, there is the option of getting more information by requesting help from within the appropriate screen. If it is necessary to return to a previous screen, use the "PG UP" key.

Each of the screens is discussed in the following subsections. A hardcopy of each screen is provided as is the corresponding help screen. Since the program is self-documenting, the need for additional information has been kept to a minimum.

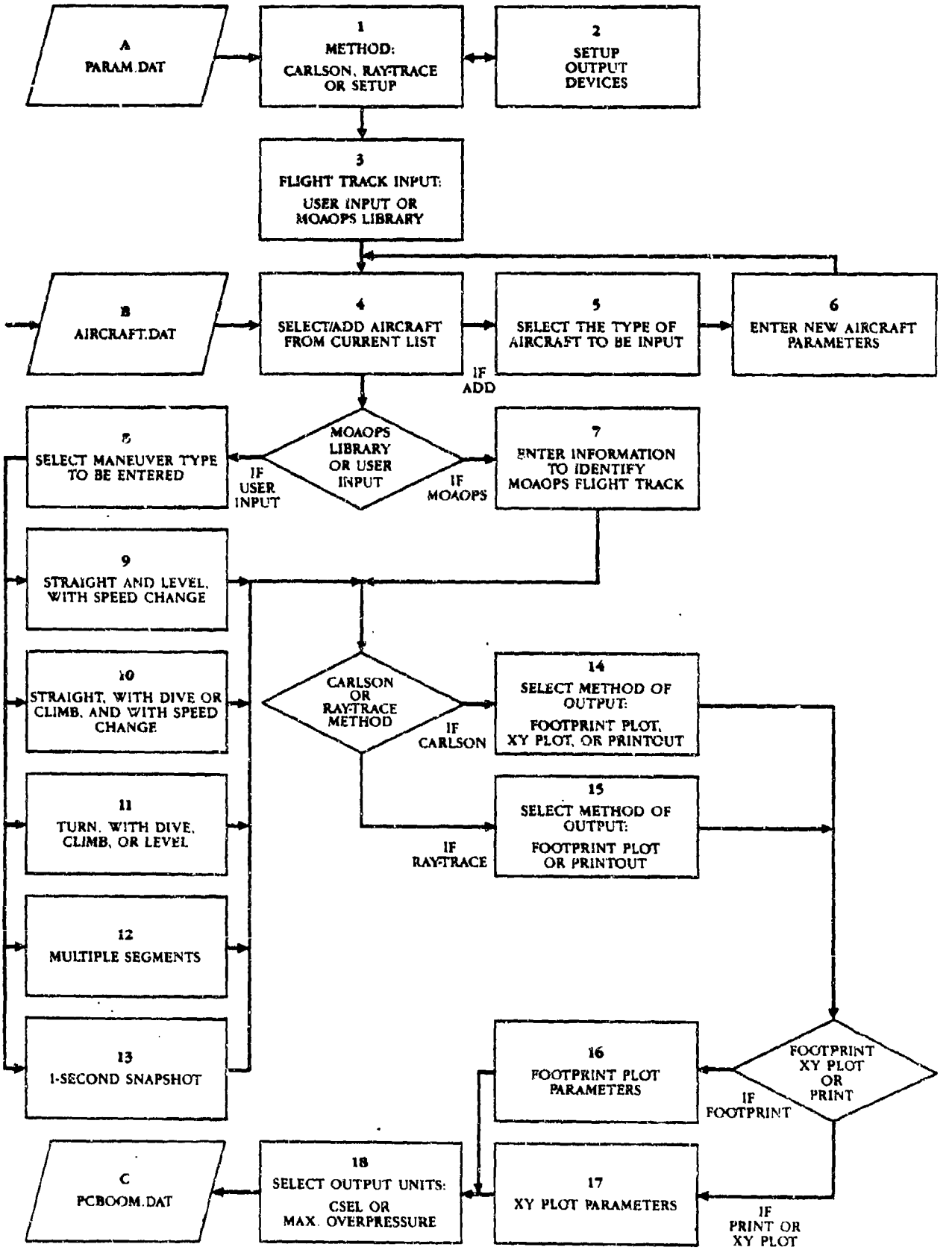
Table 2. Directory of PCBOOM Disk 1.

```
 Volume in drive A has no label
 Directory of  A:\

PCBM     EXE   296584  10-08-88  10:56p
PCBOOM   BAT      107   2-17-88  11:25a
        2 File(s)     64512 bytes free
```

Table 3. Directory of PCBOOM Disk 2.

```
 Volume in drive A has no label
 Directory of  A:\

SPINONE  EXE   167948   7-23-88  12:54p
PARAM    DAT       88   5-11-88   3:46p
HLPGS1   DAT     1241   3-03-88   3:32p
PCBOOM   DAT      815  10-25-88   1:30p
HELP1    DAT      983   2-26-88  10:19a
HLP15A   DAT     1185   5-18-88   4:33p
HELP12   DAT      636   3-09-88   6:38p
AIRCRAFT DAT      883   3-15-88  12:02p
HLPIO1   DAT      798  10-24-88   4:09p
HELP17   DAT      394   1-08-88  12:46p
HLPIO2   DAT     1424  10-24-88   4:10p
HELP3    DAT      890   2-17-88   5:22p
HELP4    DAT      607   2-17-88   7:41p
HELP5    DAT      567   3-09-88   6:33p
HLPIO3   DAT      714  10-24-88   4:10p
HELP8    DAT     1283   2-20-88   1:03p
HELP9    DAT     1552   2-20-88   1:05p
HELP11   DAT     1547   3-31-88  11:25a
HELP18   DAT     1034  10-24-88   4:12p
PCBM     DAT      508   1-08-88   2:44p
HLPGS2   DAT     1092   3-21-88   3:08p
HELP10   DAT     1336   3-09-88   6:37p
HELP14   DAT      610   5-02-88  11:43a
HELP2    DAT      903  10-22-88  10:42p
HELP6    DAT      752  10-22-88  10:43p
HELP7    DAT      829  10-22-88  10:46p
HELP13   DAT     1188  10-22-88  10:49p
HELP16   DAT      709  10-22-88  10:50p
       28 File(s)     155648 bytes free
```

Figure 1. Flow Chart of the Screens Presented in this Manual



3.2.1 Selection of method

Screen 1 allows the user to select the form of calculations to be performed. Carlson's method makes many simplifications and is accurate only for straight and level flights. Since it executes much faster than the ray trace method, it can be used to make a first order estimate of overpressure for more complex maneuvers. To get a more accurate estimate of overpressure from maneuvers, the ray trace method should be selected. The ray trace method also estimates the overpressure from focused booms.

3.2.2 Set up output devices

Screen 2 allows the user to select the output devices. One device is selected for plotting flight tracks, altitude and mach profiles. A second device is selected for printed tables, and a third device for sideline and footprint plots.

3.2.3 Entering flight track data

Screen 3 is used to determine whether the user wants to enter a maneuver, or whether a maneuver is to be extracted from one of the four MOAOPS databases. Selection of a maneuver from a MOAOPS library must be done with care. Many of the flights in the library either contain no supersonic flight track points, or contain too many for PCBOOM to handle.

3.2.4 Selecting an aircraft

Screen 4 allows the user to select either an existing aircraft from the list provided, or to add a new aircraft to the list. To add an aircraft, one must know the length and width of the aircraft, as well as its shape factor. The data is requested by Screens 5 and 6.

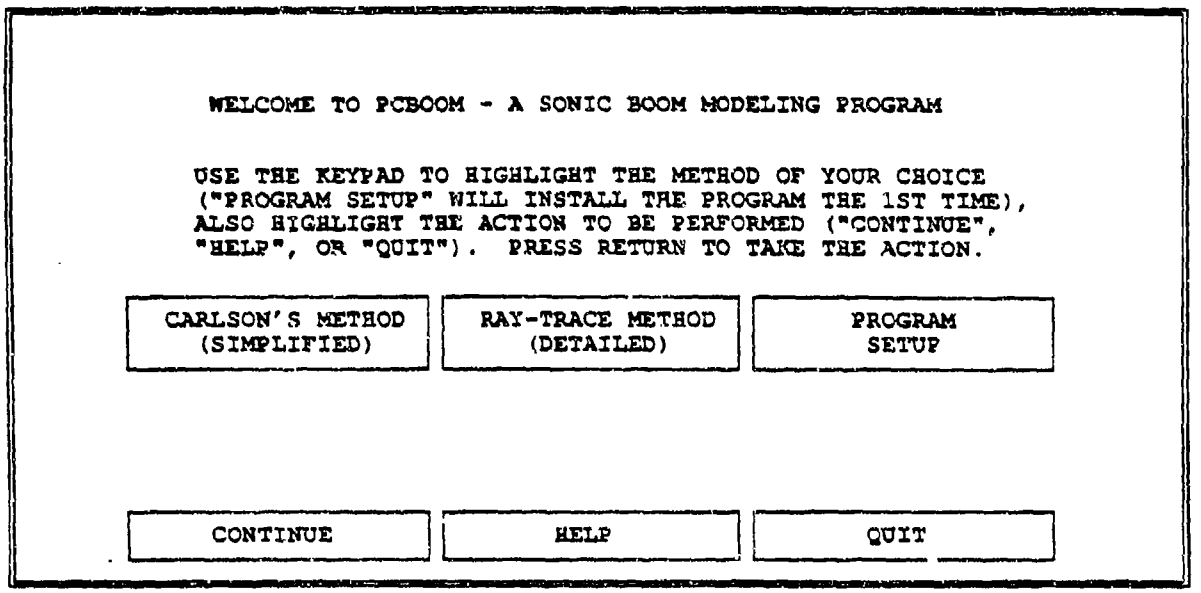
3.2.5 Selecting the aircraft type to be added

Screen 5 is required when an aircraft is added to the library. The aircraft type is used by Carlson's method to calculate its own shape factor. Select the aircraft type that best matches the aircraft you are entering.

3.2.6 Entering new aircraft data

Screen 6 is also required when an aircraft is added to the library. A unique name is requested along with the aircraft's length and weight. The shape factor is not a necessary input for the Carlson method (since it calculates its own). To calculate the shape factor for the ray trace method, first run a Carlson method job with the new aircraft's length and weight. The shape factor will be displayed on the coverpage of the plot output. Then re-enter the aircraft data using this shape factor.

Screen 1. Select Method.



CARLSON'S METHOD (SIMPLIFIED) :
This method calculates the overpressure from straight, constant speed flights (maneuvers, curved flight tracks etc. will be in error). Flight tracks may not exceed 106,000 feet. It does not address "skip", "over-the-top", or secondary sonic booms. See NASA Technical Paper 1122, "SIMPLIFIED SONIC BOOM PREDICTION", by Harry W. Carlson, March 1978.

RAY-TRACE METHOD (DETAILED) :
This method offers a more exact and time consuming approach. Each flight track point will require approximately 30 minutes of execution time (more for accelerations). This method also calculates the locations of any "focused" booms. See BBN Report 6489, "BOOMAP2 COMPUTER PROGRAM FOR SONIC BOOM RESEARCH: VOLUME 1. TECHNICAL REPORT", BY D.E. Bishop, J.M. Haber, E.G. Wilby, August 1987.

PRESS ANY KEY TO CONTINUE

Screen 2. Set Up Output Devices.

PCBOOM SETUP

USE THE KEYPAD TO MOVE THE CURSOR TO THE IO DEVICE TO BE CHANGED, THEN SIMPLY OVERWRITE THE CURRENT DEFAULT VALUE. "PG UP" WILL RETURN TO THE PREVIOUS SCREEN. ALSO HIGH - LIGHT THE ACTION TO BE PERFORMED ("CONTINUE", "HELP", OR "QUIT"). PRESS RETURN TO TAKE THE ACTION.

	IOPORT	MODEL
Device for plotting flight tracks, altitude and mach profiles :	99	99
Device for printed tables :	1	1
Device for sideline and footprint plots :	1	1

CONTINUE | HELP | QUIT

Printer device (IOPORT & MODEL) :
The following screens contain the recommended "IOPORT", and "MODEL" settings for the printing devices supported by this package.

Plotter device (IOPORT & MODEL) :
The following screens contain the recommended "IOPORT", and "MODEL" settings for the plotting devices supported by this package (these settings may be the same as the "Printer device"). To create a FOOTPRINT plot file called "BOOMPLT.DAT" enter "10". To produce the plot, quit PCBOOM, and at the MS-DOS command level type ;

"COPY BOOMPLT.DAT LPT1: /B" or "COPY BOOMPLT.DAT COM1: /B".

Screen graphics card (IOPORT & MODEL) :
Enter the same value for "IOPORT", and "MODEL".

Hercules Graphics Card	: 93
IBM Enhanced Graphics Adaptor (EGA)	: 96 or 97
IBM Color Graphics Adaptor (CGA)	: 99

PRESS ANY KEY FOR NEXT HELP SCREEN

Screen 2. Set Up Output Devices. (cont'd)

Select an IOPORT for the screen, printer, and plotter :

SCREEN		IOPORT
Hercules Graphic Card	:	93
EGA	:	94 or 95 or 96 or 97
CGA	:	99
PARALLEL PRINTER/PLOTTER:		
PRN (same as LPT1)	:	0
LPT1	:	1
LPT2	:	2
LPT3	:	3
DISK FILE "BOOMPLT.DAT"	:	10

SERIAL PRINTER/PLOTTER : 'BBCP', WHERE:

'BB' IS THE BAUD RATE : 3=300, 12=1200, 24=2400, 48=4800, 96=9600
'C' IS THE SERIAL PORT : 0=COM1, 5=COM2
'P' IS TH PARITY/# DATA BITS: 0= NONE/8 BITS, 1= ODD/7 BITS, 2= EVEN/7 BITS
Example: 9600 baud on COM2, odd parity and 7 bits = 9651.

PRESS ANY KEY FOR NEXT HELP SCREEN

Select a MODEL for the screen, printer, and plotter :

OUTPUT DEVICE	MODEL	OUTPUT DEVICE	MODEL
EPSON FX-80	5	EPSON FX-80+	5
EPSON JX-80	5	EPSON FX-85	5
EPSON FX-185	15	EPSON FX-286	15
EPSON MX-80	1	EPSON RX-80	1
EPSON FX-100	15	EPSON FX-100+	15
EPSON MX-100	11	EPSON RX-100	11
EPSON LQ-1500	41	IBM GRAPHICS PRINTER	1
IBM PROPRINTER	1	CENTRONICS GLP	1
OKIDATA 92	1	OKIDATA 93	11
OKIDATA 182	1	OKIDATA 192	1
OKIDATA 193	11	HI DMP-51	51
HI DMP-52	51	HI DMP-56A	51
ENTER SP-600	30	ENTER SP1000	80
ENTER SP1200	51	IOLINE LP3700	51
HP 7440A	80	HP 7470A	20
HP 7475A	30	HP 7550A	80

PRESS ANY KEY FOR NEXT HELP SCREEN

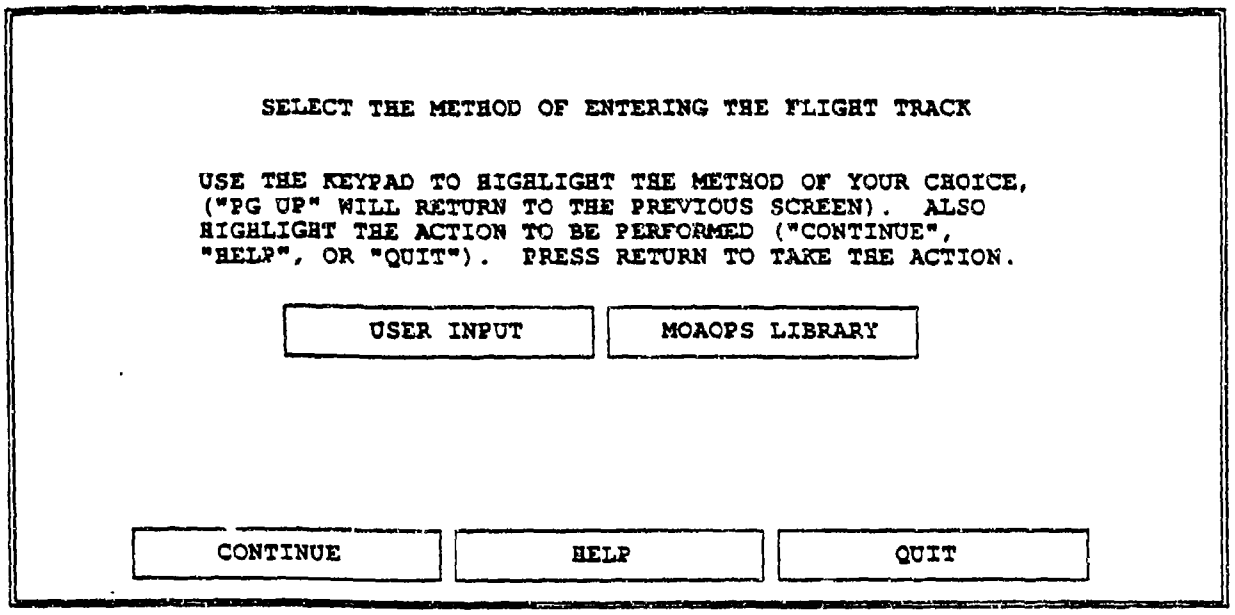
Screen 2. Set Up Output Devices. (cont'd)

Select a MODEL for the screen, printer, and plotter :

OUTPUT DEVICE	MODEL
HP 7570A	80
HP 7580B	80
HP 7585B	80 or 85
HP 7586B	80 or 85
HP 7595A	80 or 85
HP 7596A	80 or 85
HP THINKJET (2225A)	70
HP QUIETJET (2228A)	72
HP QUIETJET PLUS (2227A)	75
HP LASERJET PRINTERS	60 or 61
TEKTRONIX 4025	90
HERCULES GRAPHICS CARD	93
IBM EGA	97
IBM COLOR GRAPHICS ADAPTER	99

PRESS ANY KEY TO CONTINUE

Screen 3. Enter Flight Track Data.



USER INPUT :
The user can create a flight track using one of the four maneuver types currently available, a flight track made up of up to 10 linear segments, or a one second "snapshot". Prompts will appear for the necessary input.

MOAOPS LIBRARY :
The "MOAOPS" library files "INDEX" and "LIBRY" must be resident on the current directory and drive, or they must be on floppy disk in drive A. The user will be prompted for the mission identifier, site identifier, aircraft type, and aircraft tail number on the following screen. If one or more of these are unknown, "ALL" may be entered. The program will then use the first flight track it finds which matches the other inputs.

PRESS ANY KEY TO CONTINUE

Screen 4. Select Aircraft to Use.

SELECT AN AIRCRAFT FROM THE CURRENT AIRCRAFT LIST

USE THE KEYPAD TO SCROLL THE AIRCRAFT LIST UNTIL THE DESIRED AIRCRAFT IS IN THE DARKENED AREA. EXIT THE LIST USING "PG DN" OR "END". TO ADD A NEW AIRCRAFT, PRESS "A". ENTERING "PG UP" WILL RETURN TO THE PREVIOUS SCREEN. ALSO HIGHLIGHT THE ACTION TO BE PERFORMED ("CONTINUE", "HELP", OR "QUIT"). PRESS RETURN TO TAKE THE ACTION.

AIRCRAFT	LENGTH	WEIGHT	S-FACTOR
F-4	58.20	56.00	.0880
F-5	46.60	19.60	.0642
F-8	54.50	32.30	.0870
F-14	62.70	56.70	.0873
F-15	63.80	42.30	.0838
F-16	47.60	23.30	.0838
F-18	56.00	49.30	.0900
F-20	46.50	26.10	.0643
F-101	71.10	48.40	.0860

CONTINUE | HELP | QUIT

This window displays 9 of the aircraft currently existing in the "MOAOPS" library (as well as a few others!). Use the up and down arrow keys to scroll the list, until the desired aircraft is in the shaded area. Then hit the return key while "CONTINUE" is highlighted. An aircraft may be added to the list by hitting the "A" key. The next two screens will prompt for the necessary information. The parameter "S_FACTOR" is the shape factor of the aircraft (Ks in Carlson). The Carlson method automatically calculates the shape factor, so it is only a necessary input when running the ray-trace program. This list is saved in the file "AIRCRAFT.DAT". Aircraft may be deleted from it using any editor.

PRESS ANY KEY TO CONTINUE

Screen 5. Select Aircraft to Add.

SELECT AIRCRAFT TYPE TO BE ADDED TO DATA FILE

USE THE KEYPAD TO HIGHLIGHT THE DESIRED AIRCRAFT TYPE.
HITTING THE "PG DN" OR "END" KEY WILL EXIT THESE WINDOWS
THE "PG UP" KEY WILL RETURN TO THE PREVIOUS SCREEN.
ALSO HIGHLIGHT THE ACTION TO BE PERFORMED ("CONTINUE",
"HELP", OR "QUIT"). PRESS RETURN TO TAKE THE ACTION.

1) LARGE FIGHTER
2) SMALL FIGHTER
3) MEDIUM BOMBER
4) LARGE BOMBER
5) SHUTTLE ORBITER
6) FIXED-WING FIGHTER
7) VARIABLE-SWEEP AIRCRAFT
8) CONCORDE

CONTINUE	HELP	QUIT

In order to calculate the shape factor of the aircraft, the Carlson method must know the general type of the aircraft. These are the eight types of aircraft the program is currently able to generate a shape factor for.

Use the up and down arrow keys (the HOME, END, and PG DN keys will jump the cursor, the PG UP key will back up one screen) and highlight the aircraft type to be entered. Then hit the return key while "CONTINUE" is highlighted.

PRESS ANY KEY TO CONTINUE

Screen 6. Enter Aircraft Data.

ENTER NEW AIRCRAFT DATA

USE THE KEYPAD TO MOVE THE CURSOR TO THE CORRECT WINDOW, THEN ENTER THE NEW AIRCRAFT INFORMATION. PRESSING THE "PG UP" KEY WILL RETURN TO THE PREVIOUS SCREEN. ALSO HIGHLIGHT THE ACTION TO BE PERFORMED ("CONTINUE", "HELP" OR "QUIT"). PRESS RETURN TO TAKE THE ACTION.

Aircraft name :

Aircraft length (ft) :

Aircraft weight (klbs) :

Aircraft shape factor :

CONTINUE	HELP	QUIT

Please enter each of the four parameters including the decimal place. When entering the aircraft name, do not put any spaces around the dash (i.e. F-15, NOT F - 15). The parameter "S-FACTOR" is only necessary for the Ray-Trace method; it is calculated in the Carlson method.

Once entered, the new aircraft will be stored in file "AIRCRAFT.DAT". Aircraft can be deleted from this file with any editor.

PRESS ANY KEY TO CONTINUE

3.2.7 Selecting from the MOAOPS library

Screen 7 is used for selecting an operation from a MOAOPS library. The appropriate disk with the desired library should be placed in Drive "A" of the computer. Flight tracks information is selected based upon the desired aircraft name, mission identification, site name, and aircraft tail number.

Many of the entries in the MOAOPS library are not suitable for processing because the operation contains too few or too many flight segments. It is wise to first process a MOAOPS operation using Carlson's method to verify that the operation is satisfactory for processing with ray tracing.

3.2.8 User-defined inputs

Screen 8 allows the user to select five different types of operations ranging from a simple straight and level flight, to an operation with a turn and/or climb or dive. It also allows for long straight flight segments for operations covering long distances. A sixth option is also provided that allows the user to get overpressure versus distance information for a single point using Carlson's method.

3.2.9 Straight and level with speed change

Screen 9 is used when the user requests a flight track that has no turns, does not climb or dive, and has a speed change. The user must be careful that the desired speed change can be accomplished in a reasonable amount of time, assuming the provided acceleration. The help screen provided with this screen will assist the user in selecting a reasonable acceleration.

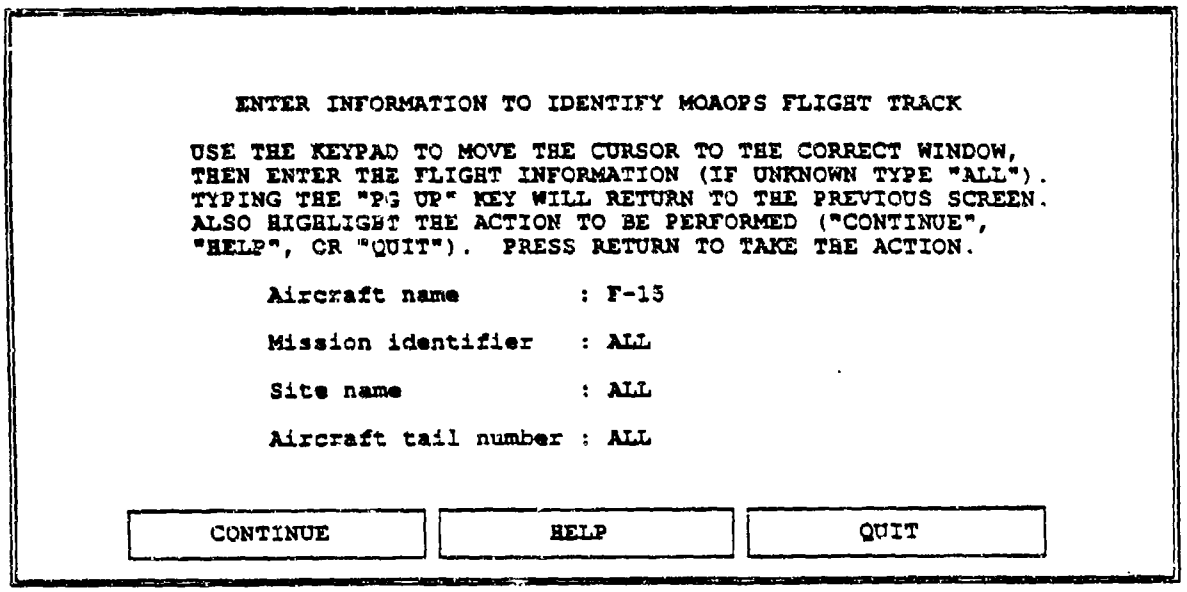
3.2.10 Straight with climb/dive and speed change

Screen 10 is similar to Screen 9 except it allows for a climb or dive angle. In addition to the climb or dive angle of the current segment, the program needs the angles for the previous and the following segments.

3.2.11 Turn with constant speed

Screen 11 is used for operations that perform a change in heading. If a dive or climb is to be performed, the user must provide the necessary climb/dive angle. A climb/dive angle of 0.0 results in a level flight.

Screen 7. Select from MOAOPS Library.



Aircraft name :
Enter aircraft name of up to 6 characters. Do not put spaces around a dash (i.e., F-16, not F - 16).

Mission identifier :
Enter mission identifier of up to 16 characters.

Site name :
Enter site identifier of up to 8 characters.

Aircraft tail number :
Enter aircraft tail number of up to 8 characters.

If one or more of these parameters is unknown, enter "ALL" for that parameter. For example, if "ALL" is entered for the site name, the program will use the first flight track it finds that matches the other three parameters.

PRESS ANY KEY TO CONTINUE

Screen 8. User-Defined Inputs.

SELECT DESIRED MANEUVER TYPE

USE THE KEYPAD TO HIGHLIGHT ONE MANEUVER TYPE AND ONE ACTION TO BE PERFORMED ("CONTINUE", "HELP", OR "QUIT"). THE "PG DN" AND "END" KEYS WILL MOVE THE CURSOR TO THE LOWER WINDOWS. THE "PG UP" KEY WILL RETURN TO THE PREVIOUS SCREEN. PRESS RETURN TO TAKE THE ACTION.

1) Straight and level, w/speed change
2) Straight, dive/climb, w/speed change
3) Constant turn, level, constant speed
4) Constant turn, dive/climb, constant speed
5) Flight track segments (up to 10)
6) Snapshot - 1 flight track point

CONTINUE | HELP | QUIT

These are the five types of flight tracks, and an option to enter a single flight track point, that may be currently entered.

The fifth choice, "flight track segments", will allow the user to string up to 10 linear flight track segments together. It is also the only flight track type in which the user can create a flight track of over 98 points. In this case, the program will cut down the total number of points actually used to a reasonable number.

Use the up and down arrow keys to highlight the method of choice, then hit return while "CONTINUE" is also highlighted. The next help screen will prompt the user for the necessary inputs.

PRESS ANY KEY TO CONTINUE

Screen 9. Straight and Level with Speed Change.

STRAIGHT AND LEVEL FLIGHT TRACK, WITH SPEED CHANGE

USE THE KEYPAD TO MOVE TO THE PARAMETER TO BE CHANGED, THEN SIMPLY OVERWRITE THE INITIAL VALUE. "PG UP" WILL RETURN TO THE PREVIOUS SCREEN. ALSO HIGHLIGHT THE ACTION TO BE PERFORMED ("CONTINUE", "HELP", OR "QUIT"). PRESS RETURN TO TAKE THE ACTION.

Enter entry mach number	:	1.00
Enter exit mach number	:	1.00
Enter the accaleration in G's	:	1.00
Enter aircraft altitude (FT)	:	10000.0
Enter ground height (FT)	:	.0
Enter border segment size (SEC)	:	3

CONTINUE | HELP | QUIT

Please enter each of the parameters including the decimal point. The aircraft altitude, and ground height will be constant throughout the flight track. The "acceleration in G's" correspond to the "entry and exit mach number". Use caution that the aircraft will be able to accelerate from the entry mach to the exit mach in a reasonable number of seconds. The next help screen offers some guidelines for this parameter. Once the flight track has been calculated, the program will display the total number of points in the flight track, and the user has the option to continue. The flight track will be preceded and followed by a three second segment (of the same speed as the first and last flight track points, respectively).

Use the up and down arrow keys (the HOME, END, and PG DN keys will jump the cursor, the PG UP key will back up one screen), to position the cursor in the correct window. Then overwrite the initial value. Hit the return key while "CONTINUE" is highlighted to enter the values and move on to the next screen.

PRESS ANY KEY FOR THE NEXT HELP SCREEN

Screen 9. Straight and Level with Speed Change. (cont'd)

HELP TABLE FOR ACCELERATION IN G'S

For "straight line" acceleration, rates of acceleration along the line of flight translate as follows :

In G's	In feet/sec/sec	In knots/sec
0.1	3.2	1.9
0.2	6.4	3.8
0.5	16.1	9.5
1.0	32.2	19.1
1.5	48.3	28.6
2.0	64.4	38.2

Linear acceleration along the flight path for fighter aircraft can range from 0 g in a steady climb to 0.4 g in level flight with maximum available thrust at 10,000 feet altitude. The linear acceleration in a dive can range up to 0.8 g or more (please see the Users Manual for more detail).

PRESS ANY KEY TO CONTINUE

Screen 10. Straight with Climb/Dive and Speed Change.

STRAIGHT FLIGHT TRACK, WITH DIVE/CLIMB AND SPEED CHANGE

USE THE KEYPAD TO MOVE TO THE PARAMETER TO BE CHANGED, THEN SIMPLY OVERWRITE THE INITIAL VALUE. "PG UP" WILL RETURN TO THE PREVIOUS SCREEN. ALSO HIGHLIGHT THE ACTION TO BE PERFORMED ("CONTINUE", "HELP", OR "QUIT"). PRESS RETURN TO TAKE THE ACTION.

Enter entry mach number	:	1.00
Enter exit mach number	:	1.00
Enter the acceleration in G's	:	1.00
Enter entry altitude (FT)	:	10000.0
Enter ground height (FT)	:	.0
Enter entry c/d angle (DEG)	:	.0
Enter maneuvers c/d ang. (DEG)	:	.0
Enter exit c/d angle (DEG)	:	.0
Enter border segment size (SEC)	:	3

CONTINUE | HELP | QUIT

Please enter each of the parameters including the decimal point. The ground height will be constant throughout the flight track. The "acceleration in G's" must correspond to the "entry and exit mach number". Use caution that the aircraft will be able to reach the exit mach number in a reasonable number of points. The next help screen offers some guidelines for this parameter. Once the flight track has been calculated, the program will display the number of points required for the aircraft to reach the exit mach. The flight track will be preceded and followed by a three second segment (of the same speed as the first and last flight track points, respectively). The "entry c/d angle" is the climb/dive angle of the preceding segment. Similarly, the "exit c/d angle" is the climb/dive angle of the following segment, while "maneuvers c/d angle" is the climb/dive angle of the actual maneuver.

Use the up and down arrow keys (the HOME, END, and PG DN keys will jump the cursor, the PG UP key will back up one screen), to position the cursor in the correct window. Then overwrite the initial value. Hit the return key while "CONTINUE" is highlighted to enter the values and move on to the next screen. Please see the Users Guide for more information on these input parameters.

PRESS ANY KEY FOR THE NEXT HELP SCREEN

Screen 10. Straight with Climb/Dive and Speed Change. (cont'd)

HELP TABLE FOR ACCELERATION IN G'S

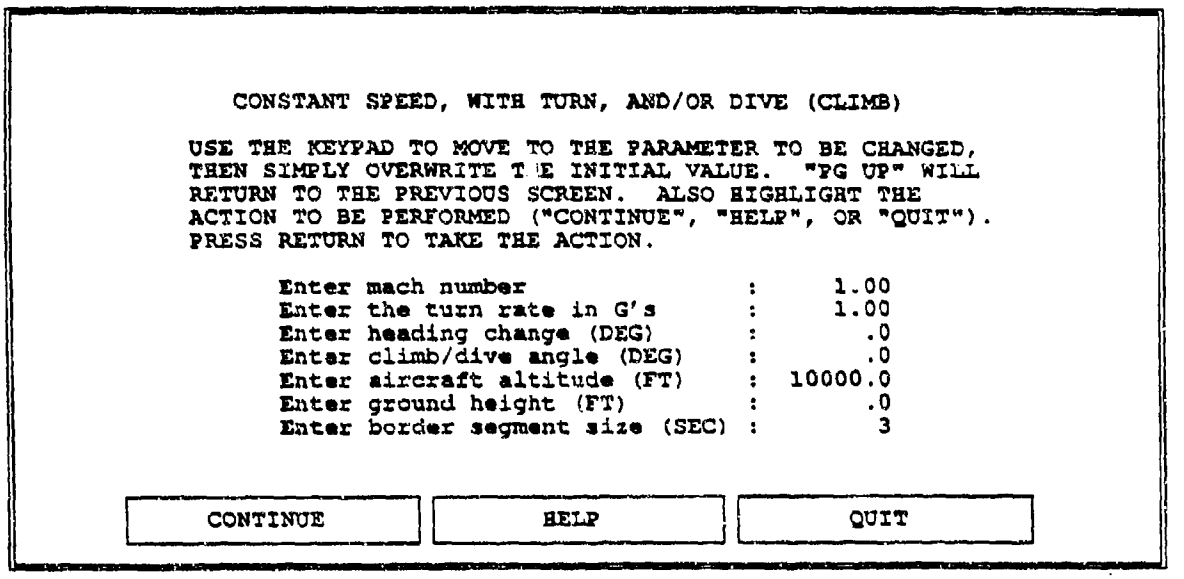
For "straight line" acceleration, rates of acceleration along the line of flight translate as follows :

In G's	In feet/sec/sec	In knots/sec
0.1	3.2	1.9
0.2	6.4	3.8
0.5	16.1	9.5
1.0	32.2	19.1
1.5	48.3	28.6
2.0	64.4	38.2

Linear acceleration along the flight path for fighter aircraft can range from 0 g in a steady climb to 0.4 g in level flight with maximum available thrust at 10,000 feet altitude. The linear acceleration in a dive can range up to 0.8 g or more (please see the Users Manual for more detail).

PRESS ANY KEY TO CONTINUE

Screen 11. Turn with Constant Speed.



Please enter each of the parameters including the decimal point. The aircraft mach number, and ground height will be constant throughout the flight track. The "turn rate in G's" is the number of G's the aircraft is pulling as it turns towards the "heading change". Caution must be taken that the aircraft can reach the final heading, while pulling the entered number of G's, in a reasonable number of seconds. The next help screen offers some guidelines for this parameter. The program will display the number of points in the flight track before processing. If the level flight track was chosen, enter a "climb/dive angle" of 0.0 degrees. The flight track will be preceded and followed by a three second segment (of the same speed, heading, and climb/dive angle as the first and last flight track points, respectively).

Use the up and down arrow keys (the HOME, END, and, PG DN keys, will jump the cursor, the PG UP key will back up one screen), to position the cursor in the correct window. Then overwrite the initial value. Hit the return key while "CONTINUE" is highlighted to enter the values and move on to the next screen.

PRESS ANY KEY FOR THE NEXT HELP SCREEN

Screen 11. Turn with Constant Speed. (cont'd)

HELP TABLE FOR THE TURN RATE IN G'S

At Mach 1.0, a "standard rate" turn (3 degrees per second) has a bank angle of about 49 degrees, while a half standard rate turn (1.5 degrees per second) has a bank angle of about 35 degrees.

Turn radius in statute miles :

Bank Ang. (DEG)	G load	Mach Number 1.0	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5
10	1.02	36.69	44.40	62.01	82.56	106.05	132.47	161.82	194.11	229.34
20	1.06	16.96	20.52	28.67	38.17	49.02	61.23	177.60	89.73	106.01
30	1.15	9.86	11.92	16.65	22.17	28.48	35.58	43.46	52.13	61.59
40	1.31	6.00	7.26	10.14	13.50	17.33	21.65	26.45	31.73	37.49
50	1.56	3.54	4.29	5.99	7.97	10.24	12.79	15.63	18.75	22.15
60	2.00	1.90	2.29	3.21	4.27	5.48	6.85	8.36	10.03	11.85
70	2.92	0.82	0.99	1.38	1.84	2.36	2.95	3.61	4.33	5.11
80	5.76	0.20	0.24	0.34	0.45	0.58	0.73	0.89	1.06	1.26
85	11.47	0.05	0.06	0.08	0.11	0.14	0.18	0.22	0.27	0.31

PRESS ANY KEY TO CONTINUE

3.2.12 Linear flight track segments

Screen 12 is used to build up long flight tracks. Up to ten segments are allowed. Each segment has its own beginning and ending mach and altitude, and the heading and length. The ending mach and altitude become the beginning mach and altitude for the next segment. The program patches the pieces of flight segment together.

3.2.13 Snapshot

Screen 13 allows the user to calculate the overpressure versus distance for a single flight point. This can only be used with Carlson's method.

3.2.14 Displaying the results (Carlson)

Screen 14 gives the user the option of having the results of the calculations plotted and/or printed. It is possible to select one or more of these options.

3.2.15 Displaying the results (ray trace)

Screen 15 is like Screen 14 except for ray tracing; there is not an option for sideline plots.

3.2.16 Selecting Footprint plot options

Screen 16 is called if the user has requested Footprint plots. The user must tell the program the type of output device attached to the computer. Table 4 is a list of the devices supported by the PLOT88 Plotting Package which is provided in the help screens for both Screens 16 and 17.

If the user decides to select the necessary window for plotting for a ray trace run, it is suggested that a run using Carlson's method be made to estimate the proper limits.

To save the plot file for later plotting, enter '10' for the printer port/console option. A file named 'BOOMPCT.DAT' will be saved on the hard disk. To plot the data later, type "COPY BOOMPCT.DAT LPT1:/B", or "COPY BOOMPCT.DAT COM1:/B".

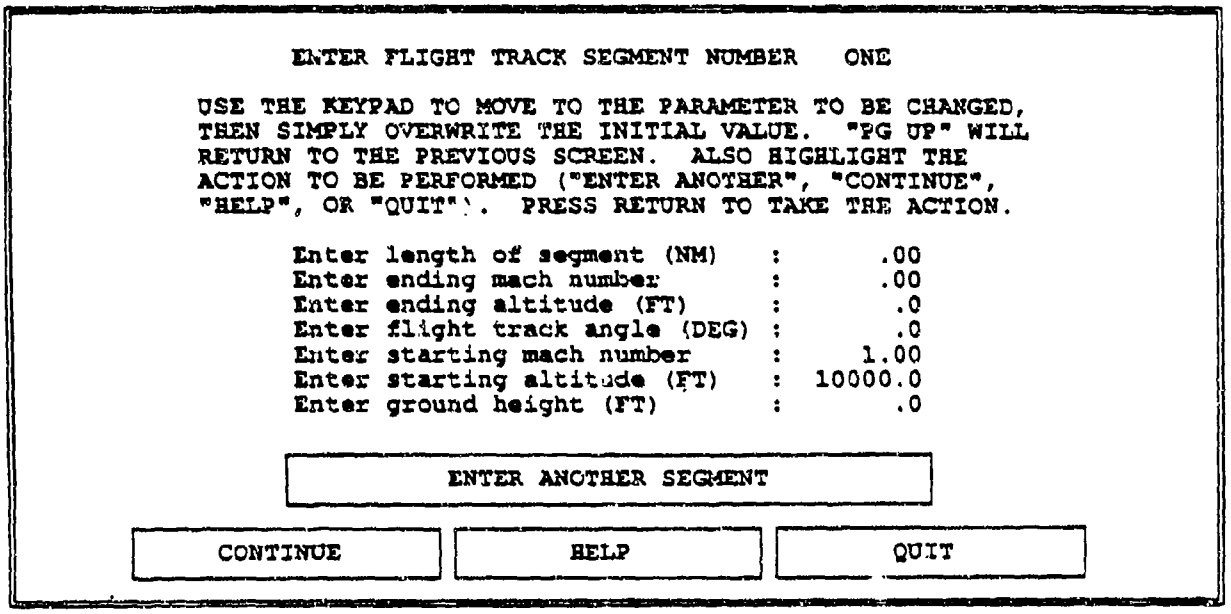
3.2.17 Selecting sideline plot options

Screen 17 is similar to Screen 16 except it is for sideline plots.

3.2.18 Selecting output units

Screen 18 lets the user select the output units. The program is capable of supplying results in the form of C-weighted sound exposure level in dB or overpressure in pounds per square foot (psf).

Screen 12. Linear Segments.



This option allows the user to string together up to ten linear flight track segments. The ground height will be constant throughout the entire string of flight track segments. Each segment is "length of segment" long in nautical miles. The last point of the first segment, becomes the first point of the second segment (etc.). "starting mach number" and "starting altitude" is defined at the first point of the first segment. Given the segments "ending mach number" and "ending altitude" the program will calculate the changing mach number, altitude, and climb/dive angle. The "flight track angle" for the first segment must be zero. Once the flight track has been calculated, the program will cut down the number of points actually used, if it exceeds 30 points (it will take every other point, or every third point etc.).

Use the up and down arrow keys (the HOME, END, and PG DN keys will jump the cursor, the PG UP key will back up one screen), to position the cursor in the correct window. Then overwrite the initial value. If "ENTER ANOTHER SEGMENT" is highlighted when return is pressed, the values are entered and the user will be prompted for the next segment. To enter the values and move on to the next screen, hit the return key while "CONTINUE" is highlighted (use the PG DN key).

PRESS ANY KEY TO CONTINUE

Screen 13. Snapshot.

ONE SECOND "SNAPSHOT" - FOR CARLSON METHOD ONLY

USE THE KEYPAD TO MOVE TO THE PARAMETER TO BE CHANGED, THEN SIMPLY OVERWRITE THE INITIAL VALUE. TYPING "PG UP" WILL RETURN TO THE PREVIOUS SCREEN. ALSO HIGHLIGHT THE ACTION TO BE PERFORMED ("CONTINUE", "HELP", OR "QUIT"). PRESS RETURN TO TAKE THE ACTION.

Enter mach number	:	1.00
Enter climb/dive angle (DEG)	:	.0
Enter aircraft altitude (FT)	:	10000.0
Enter ground height (FT)	:	.0

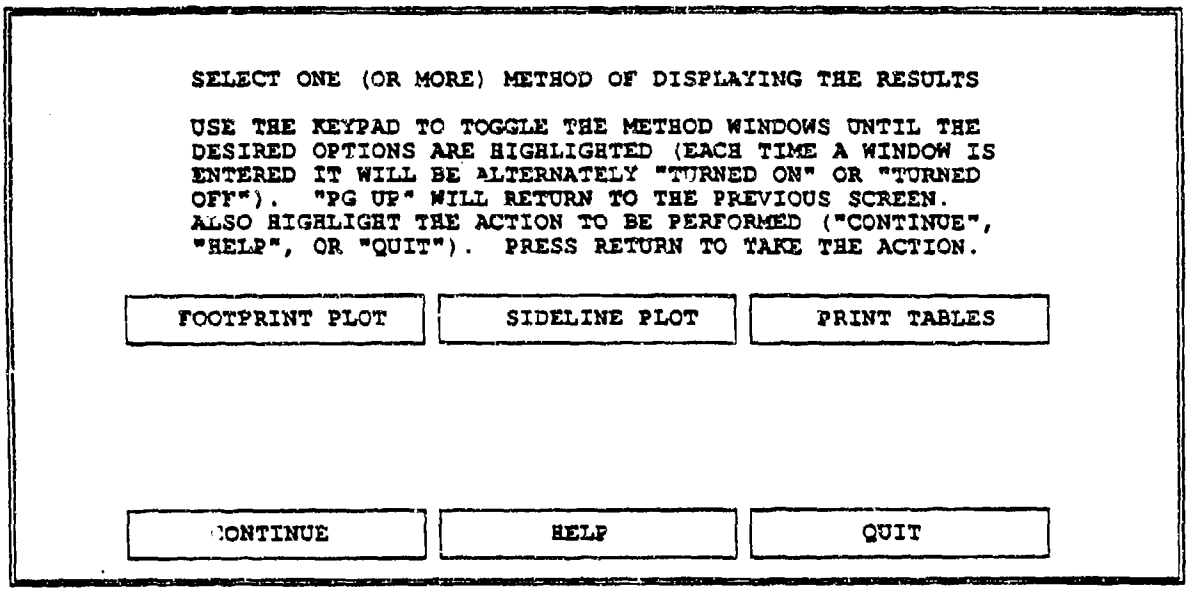
CONTINUE | HELP | QUIT

Please enter each of the parameters including the decimal point. This is a one second "snapshot" calculated by the Carlson method (for the "SIDELINE PLOT" option).

Use the up and down arrow keys (the HOME, END, and PG UP keys will jump the cursor, the PG UP key will back up one screen), to position the cursor in the correct window. Then overwrite the initial value. To enter the values and move on to the next screen, hit the return key while "CONTINUE" is highlighted.

PRESS ANY KEY TO CONTINUE

Screen 14. Display Carlson Results.



FOOTPRINT PLOT :
Create a "footprint" plot of the overpressure or CSEL values. A curve of the sonic boom overpressures will be drawn for each flight track point. A plot will be created for each 5 dB level. The next screen prompts for the specific plotting options available.

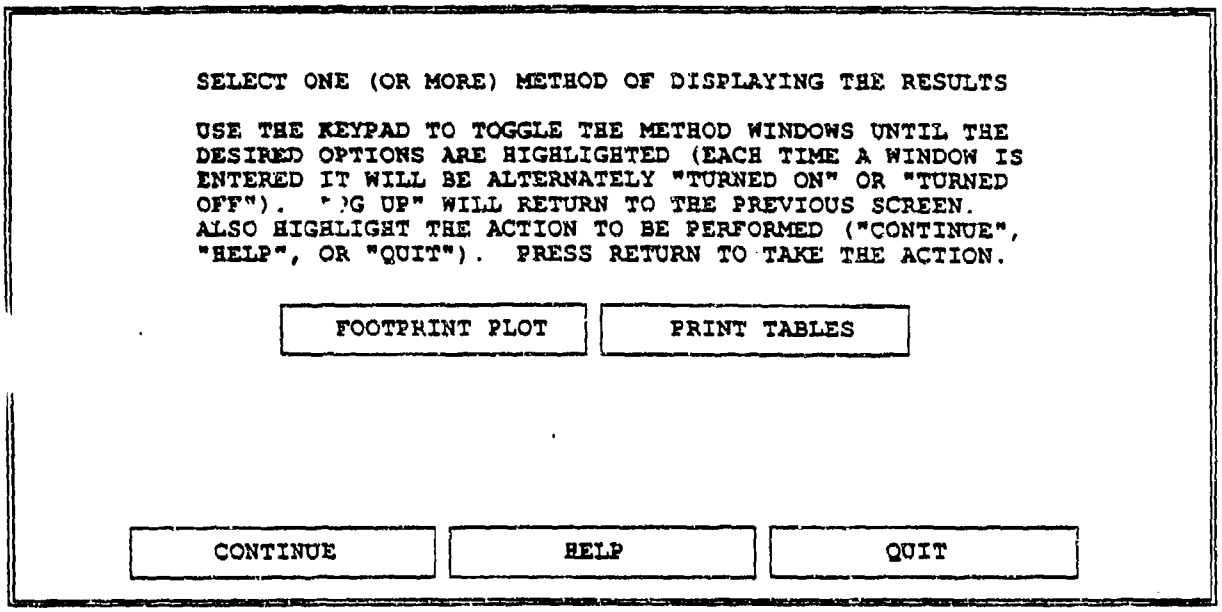
SIDELINE PLOT :
The overpressure or CSEL as a function of distance from the flight track center line. This option is only available with the Carlson method. The user does not have to create a plot for every flight track point. The following screen will prompt the user for the interval to create the plots for (i.e., entering "1" will create a plot for every flight track point, entering "2" will create a plot for every other flight track point etc.). The first and last flight track point will always be created.

PRINT RESULTS :
The overpressure and CSEL values and location are sent to the printing port in tabular form.

NOTE: THESE WINDOWS ARE TOGGLES; MORE THAN ONE MAY BE "TURNED ON".

PRESS ANY KEY TO CONTINUE

Screen 15. Display Ray Trace Results.



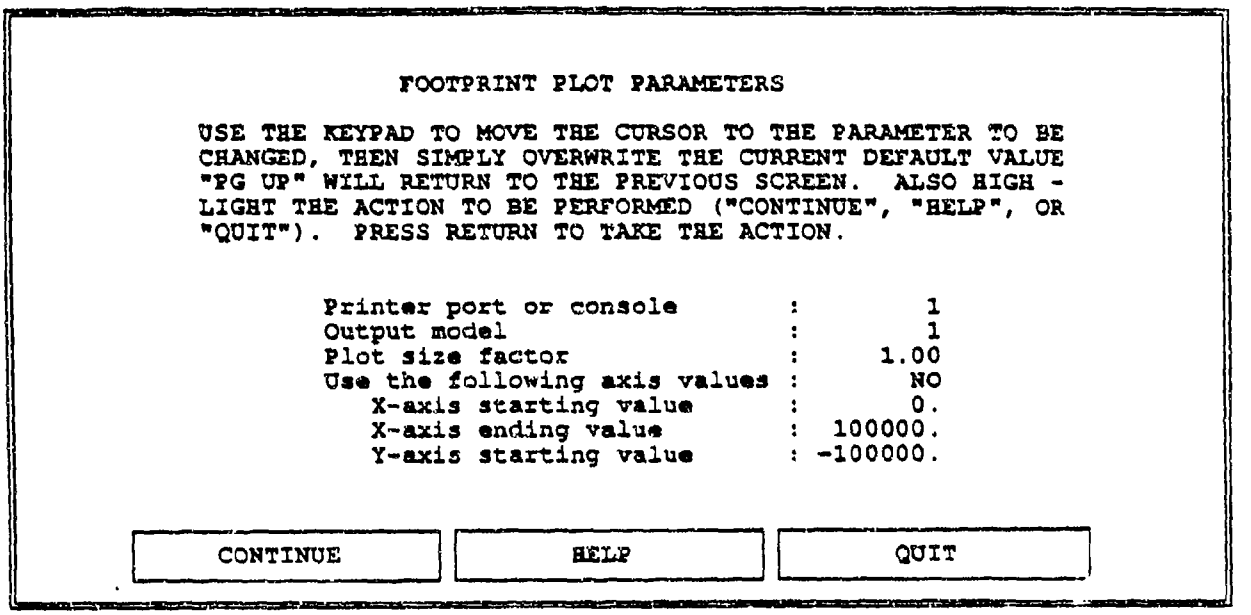
FOOTPRINT PLOT :
Create a "footprint" plot of the overpressure or CSEL values.
A curve of the sonic boom overpressures will be drawn for each flight track point. A plot will be created for each 5 dB level.
The next screen prompts for the specific plotting options available.

PRINT RESULTS :
The overpressure and CSEL values and location are sent to the printing port in tabular form.

NOTE: THESE WINDOWS ARE TOGGLES; MORE THAN ONE MAY BE "TURNED ON".

PRESS ANY KEY TO CONTINUE

Screen 16. Footprint Plot Options.



Printer port or console :
Enter the recommended setting for "IOPORT" on following help screens. To create a FOOTPRINT plot file called "BOOMPLT.DAT" enter "10". To produce the plot, quit PCBOOM, and at the MS-DOS command level type : "COPY BOOMPLT.DAT LPT1: /B" or "COPY BOOMPLT.DAT COM1: /B".

Output model :
Enter the recommended setting for "MODEL" on following help screens.

Plot size factor :
The user may increase or decrease the size of the plot by this factor.

Use the following axis values :
If the user wants to input the starting and ending axis values enter "YES". Then input the desired values into the remaining three input areas. The Y-axis scale will be set equal to the X-axis scale. If this parameter is set to "NO" the remaining input areas are ignored.
WARNING : The data should first be plotted by Carlson so that the axis values do not clip the data.
X-axis starting value :
X-axis ending value :
Y-axis starting value :

PRESS ANY KEY FOR NEXT HELP SCREEN

Screen 16. Contour Plot Options. (cont'd)

```
Select an IOPORT for the screen, printer, and plotter :

       SCREEN                 IOPORT
Hercules Graphic Card    :      93
EGA                      :      94 or 95 or 96 or 97
CGA                      :      99

PARALLEL PRINTER/PLOTTER:
PRN (same as LPT1)       :       0
LPT1                     :       1
LPT2                     :       2
LPT3                     :       3
DISK FILE "BOOMPLT.DAT"  :      10

SERIAL PRINTER/PLOTTER   :   'BBCP',  WHERE:

'BB' IS THE BAUD RATE        :  3=300, 12=1200, 24=2400, 48=4800, 96=9600
'C' IS THE SERIAL PORT       :  0=COM1, 5=COM2
'P' IS TH PARITY/# DATA BITS:  0= NONE/8 BITS, 1= ODD/7 BITS, 2= EVEN/7 BITS
Example: 9600 baud on COM2, odd parity and 7 bits = 9651.

                PRESS ANY KEY FOR NEXT HELP SCREEN


  Select a MODEL for the screen, printer, and plotter :

  OUTPUT DEVICE              MODEL      OUTPUT DEVICE              MODEL
  *************              *****      *************              *****
  EPSON FX-80                  5        EPSON FX-80+                 5
  EPSON JX-80                  5        EPSON FX-85                  5
  EPSON FX-185                15        EPSON FX-286                15
  EPSON MX-80                  1        EPSON RX-80                  1
  EPSON FX-100                15        EPSON FX-100+               15
  EPSON MX-100                11        EPSON RX-100                11
  EPSON LQ-1500               41        IBM GRAPHICS PRINTER         1
  IBM PROPRINTER               1        CENTRONICS GLP               1
  OKIDATA 92                   1        OKIDATA 93                  11
  OKIDATA 182                  1        OKIDATA 192                  1
  OKIDATA 193                 11        HI DMP-51                   51
  HI DMP-52                   51        HI DMP-56A                  51
  ENTER SP-600                30        ENTER SP1000                80
  ENTER SP1.00                51        IOLINE LP3700               51
  HP 7440A                    80        HP 7470A                    20
  HP 7475A                    30        HP 7550A                    80

                PRESS ANY KEY FOR NEXT HELP SCREEN
```

Screen 16. Contour Plot Options. (cont'd)

Select a MODEL for the screen, printer, and plotter :

OUTPUT DEVICE	MODEL
**********	******
HP 7570A	80
HP 7580B	80
HP 7585B	80 or 85
HP 7586B	80 or 85
HP 7595A	80 or 85
HP 7596A	80 or 85
HP THINKJET (2225A)	70
HP QUIETJET (2228A)	72
HP QUIETJET PLUS (2227A)	73
HP LASERJET PRINTERS	60 or 61
TEKTRONIX 4025	90
HERCULES GRAPHICS CARD	93
IBM EGA	97
IBM COLOR GRAPHICS ADAPTER	99

PRESS ANY KEY TO CONTINUE

Table 4. Recommended IOPORT and Model.

Output Device	IOPORT	Model
EPSON FX-80	0	5
EPSON FX-80+	0	5
EPSON JX-80	0	5
EPSON FX-85	0	5
EPSON FX-185	0	15
EPSON FX-286	0	15
EPSON MX-80	0	1
EPSON RX-80	0	1
EPSON FX-100	0	15
EPSON FX-100+	0	15
EPSON MX-100	0	11
EPSON RX-100	0	11
EPSON LQ-1500	0	41
IBM GRAPHICS PRINTER	0	1
IBM PROPRINTER	0	1
CENTRONICS GLP	0	1
OKIDATA 92	0	1
OKIDATA 93	0	11
OKIDATA 182	0	1
OKIDATA 192	0	1
OKIDATA 193	0	11
HI DMP-51	9600/9650	51
HI DMP-52	9600/9650	51
HI DMP-56A	9600/9650	51
ENTER SP-600	0	30
ENTER SP1000	9600/9650	80
ENTER SP1200	9600/9650	51
IOLINE LP3700	9600/9650	51
HP 7440A	9600/9650	80
HP 7470A	9600/9650	20
HP 7475A	9600/9650	30
HP 7550A	9600/9650	80
HP 7570A	9600/9650	80
HP 7580B	9600/9650	80
HP 7585B	9600/9650	80/85
HP 7586B	9600/9650	80/84
HP 7595A	9600/9650	80/85
HP 7596A	9600/9650	80/85
HP THINKJET (2225A)	0	70
HP QUIETJET (2228A)	0	72
HP QUIETJET PLUS (2227A)	0	75
HP LASERJET PRINTERS	9600/9650/0	60/61
TEKTRONIX 4025	4800/4850	90
HERCULES GRAPHICS CARD	93	92
IBM EGA	96 OR 97	96 OR 97
IBM COLOR GRAPHICS ADAPTER	99	99

Screen 17. Sideline Plot Options.

SIDELINE PLOT PARAMETERS

USE THE KEYPAD TO MOVE THE CURSOR TO THE PARAMETER TO BE CHANGED, THEN SIMPLY OVERWRITE THE CURRENT DEFAULT VALUE. "PG UP" WILL RETURN TO THE PREVIOUS SCREEN. ALSO HIGH - LIGHT THE ACTION TO BE PERFORMED ("CONTINUE", "HELP", OR "QUIT"). PRESS RETURN TO TAKE THE ACTION.

Printer port or console	:	1
Output model	:	1
Create plot every Nth point	:	1
Plot size factor	:	1.00

CONTINUE | HELP | QUIT

Printer port or console :
Enter the recommended setting for "IOPORT" on the following help screens.

Output device :
Enter the recommended setting for "MODEL" on the following help screens.

Create plot every Nth point :
A sideline plot will be created at every Nth flight track point. The first and last point will always be plotted. Sideline plots will only be created for boom producing points.

Plot size factor :
Allows the user to increase or decrease the size of the plot by this multiple.

PRESS ANY KEY FOR NEXT HELP SCREEN

Screen 17. Sideline Plot Options. (cont'd)

```
                    PRESS ANY KEY FOR NEXT HELP SCREEN
Select an IOPORT for the screen, printer, and plotter :

       SCREEN                  IOPORT
Hercules Graphic Card    :      93
EGA                      :      94 or 95 or 96 or 97
CGA                      :      99

PARALLEL PRINTER/PLOTTER:
PRN (same as LPT1)       :       0
LPT1                     :       1
LPT2                     :       2
LPT3                     :       3
DISK FILE "BOOMPLT.DAT"  :      10

SERIAL PRINTER/PLOTTER   :   'BBCP',  WHERE:

'BB' IS THE BAUD RATE        :  3=300, 12=1200, 24=2400, 48=4800, 96=9600
'C' IS THE SERIAL PORT       :  0=COM1, 5=COM2
'P' IS TH PARITY/# DATA BITS:  0= NONE/8 BITS, 1= ODD/7 BITS, 2= EVEN/7 BITS
Example: 9600 baud on COM2, odd parity and 7 bits = 9651.

                    PRESS ANY KEY FOR NEXT HELP SCREEN
```

Select a MODEL for the screen, printer, and plotter :

OUTPUT DEVICE	MODEL	OUTPUT DEVICE	MODEL
EPSON FX-80	5	EPSON FX-80+	5
EPSON JX-80	5	EPSON FX-85	5
EPSON FX-185	15	EPSON FX-286	15
EPSON MX-80	1	EPSON RX-80	1
EPSON FX-100	15	EPSON FX-100+	15
EPSON MX-100	11	EPSON RX-100	11
EPSON LQ-1500	41	IBM GRAPHICS PRINTER	1
IBM PROPRINTER	1	CENTRONICS GLP	1
OKIDATA 92	1	OKIDATA 93	11
OKIDATA 182	1	OKIDATA 192	1
OKIDATA 193	11	HI DMP-51	51
HI DMP-52	51	HI DMP-56A	51
ENTER SP-600	30	ENTER SP1000	80
ENTER SP1200	51	IOLINE LP3700	51
HP 7440A	80	HP 7470A	20
HP 7475A	30	HP 7550A	80

PRESS ANY KEY FOR NEXT HELP SCREEN

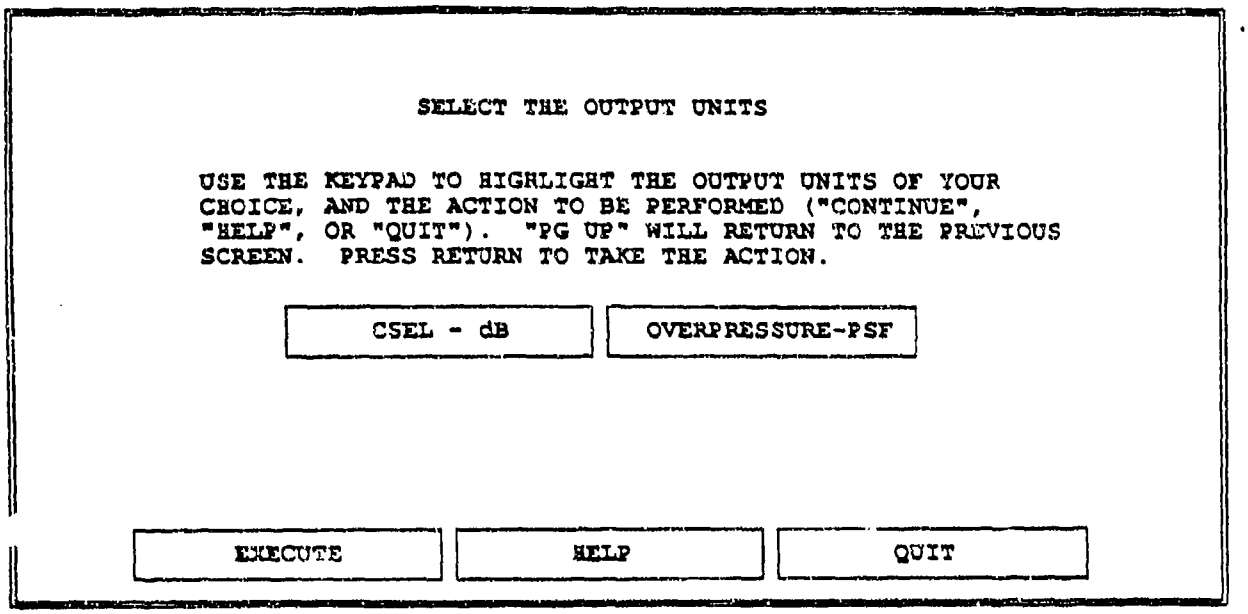
Screen 17. Sideline Plot Options. (cont'd)

Select a MODEL for the screen, printer, and plotter :

OUTPUT DEVICE	MODEL
**********	******
HP 7570A	80
HP 7580B	80
HP 7585B	80 or 85
HP 7586B	80 or 85
HP 7595A	80 or 85
HP 7596A	80 or 85
HP THINKJET (2225A)	70
HP QUIETJET (2228A)	72
HP QUIETJET PLUS (2227A)	75
HP LASERJET PRINTERS	60 or 61
TEKTRONIX 4025	90
HERCULES GRAPHICS CARD	93
IBM EGA	97
IBM COLOR GRAPHICS ADAPTER	99

PRESS ANY KEY TO CONTINUE

Screen 18. Select Output Units.



CSEL - dB :
C-Weighted Sound Exposure Level. Defined as ;

CSEL = 20.0 * LOG10(pmax) + 101.6

where, pmax = OVERPRESSURE(PSF)

OVERPRESSURE-PSF :
Sonic boom overpressure in pounds per square feet.

PRESS ANY KEY TO CONTINUE

3.3 Output Specifications

3.3.1 Output

There are several forms of output available from PCBOOM. Sample flight track, altitude, and mach profile plots are shown in Figures 2 through 4, respectively. For Carlson's method, it is possible to request a plot of the overpressure versus distance (Figure 5), or a listing of the same data (Figure 6). A footprint plot for a particular operation is available for either method. A sample footprint plot is shown in Figure 7. The aircraft position data, altitude, sonic boom position, CSEL, PSF and mach numbers are also available on disk at the end of a run. The file is called CARLDAT for a Carlson run, or RAYDAT for a ray trace run.

3.3.2 Creating a Footprint plot file

When running a large contour plot job, it may be desirable to save the Footprint plot file instead of sending it directly to the printer/plotter device. A plot file, "BOOMPLT.DAT", will be created if a "10" is entered for the first parameter (printer port or console), of the contour plot screen (Screen 15). This is an option only for the contour plots; XY (lateral), flight track, altitude, or mach plots should not be created within the same job. To display the plot file, quit PCBOOM, and at the MS-DOS command level, type:

"COPY BOOMPLT.DAT LPT1: /B"

NOTE: LPT1: may have to be replaced by COM1: depending on which port the printer/plotter device is attached.

Subsequent jobs that create a plot file will write over any files named "BOOMPLT.DAT". So be sure to rename any plot files before running another job (i.e., "RENAME BOOMPLT.DAT F15RUN1.DAT").

3.4 Errors

There are several error messages that may occur during execution of PCBOOM. Table 5 identifies these errors and explains the solution to the problem.

Figure 2. Sample Flight Track Profile Plot.

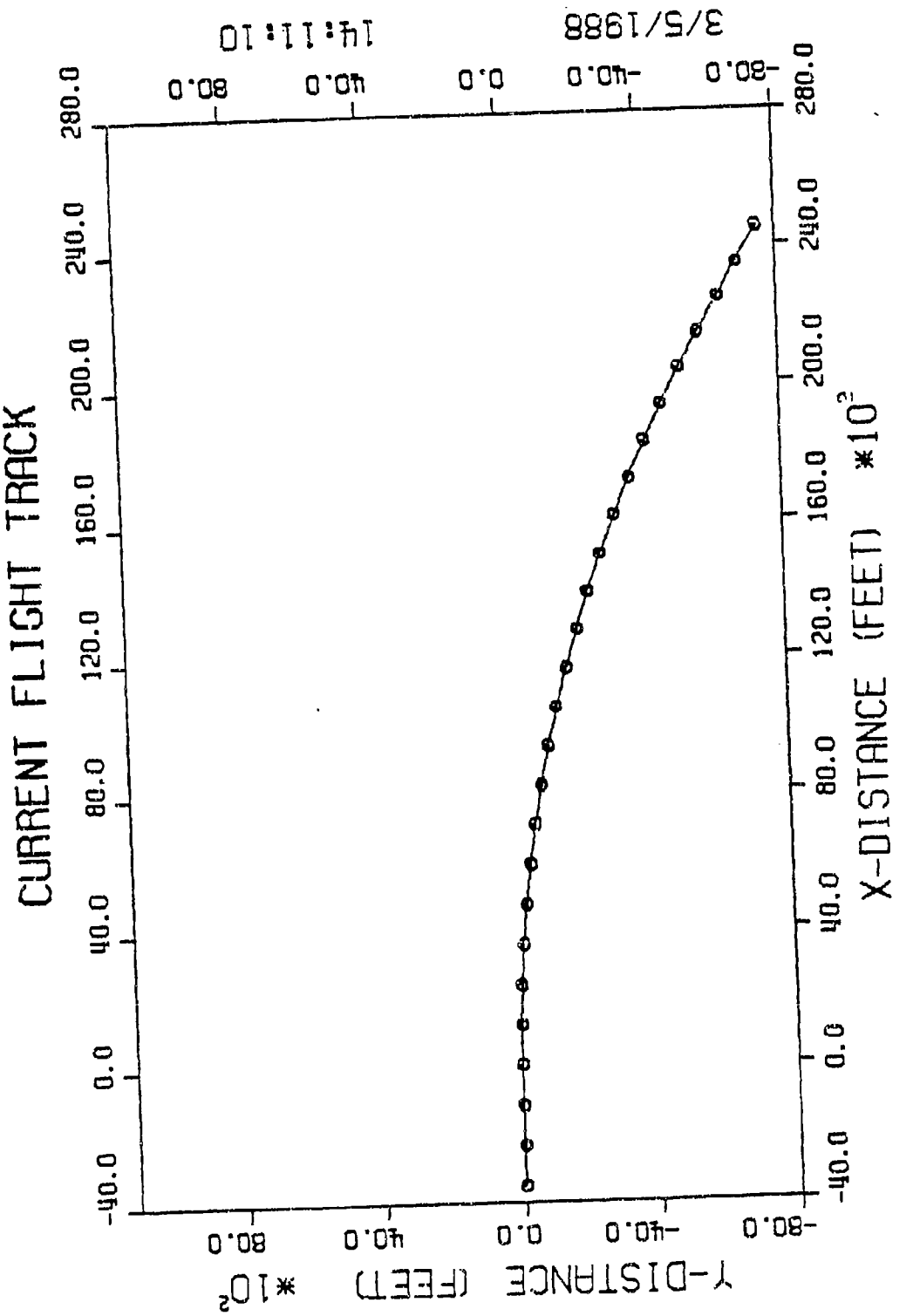


Figure 3. Sample Altitude Profile Plot.

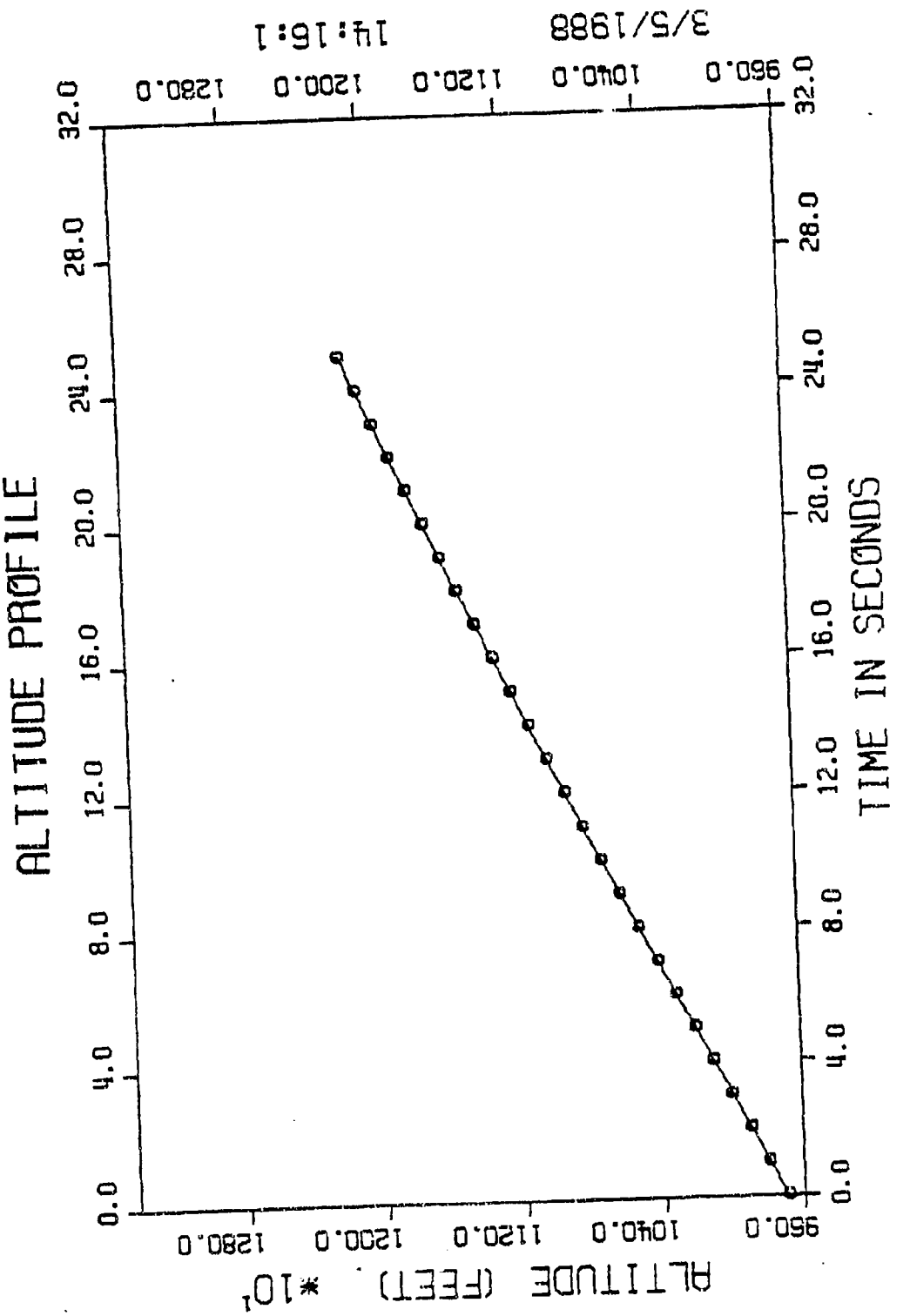


Figure 4. Sample Mach Profile Plot.

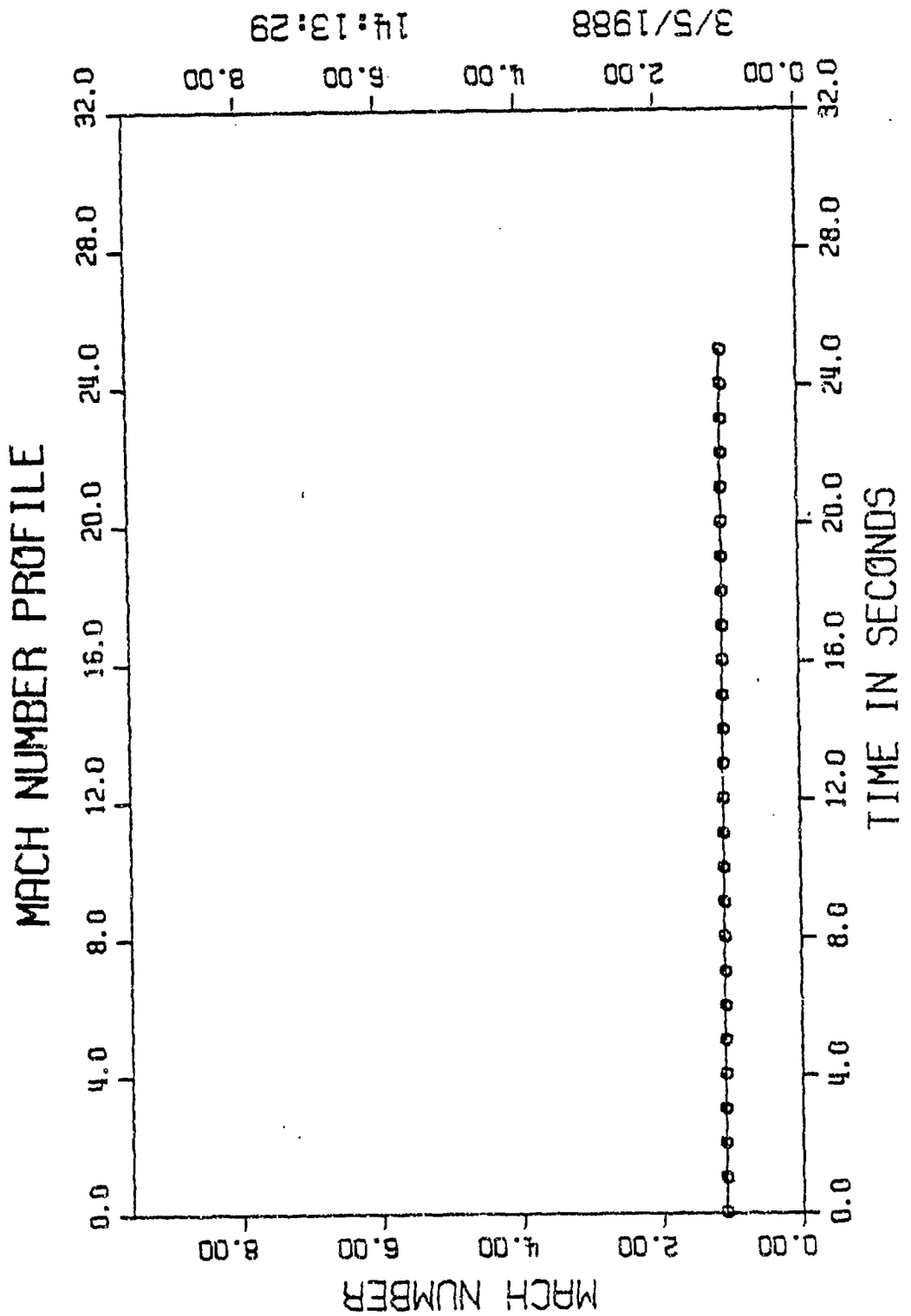


Figure 5. Overpressure versus Distance Plot from Carlson's Method.

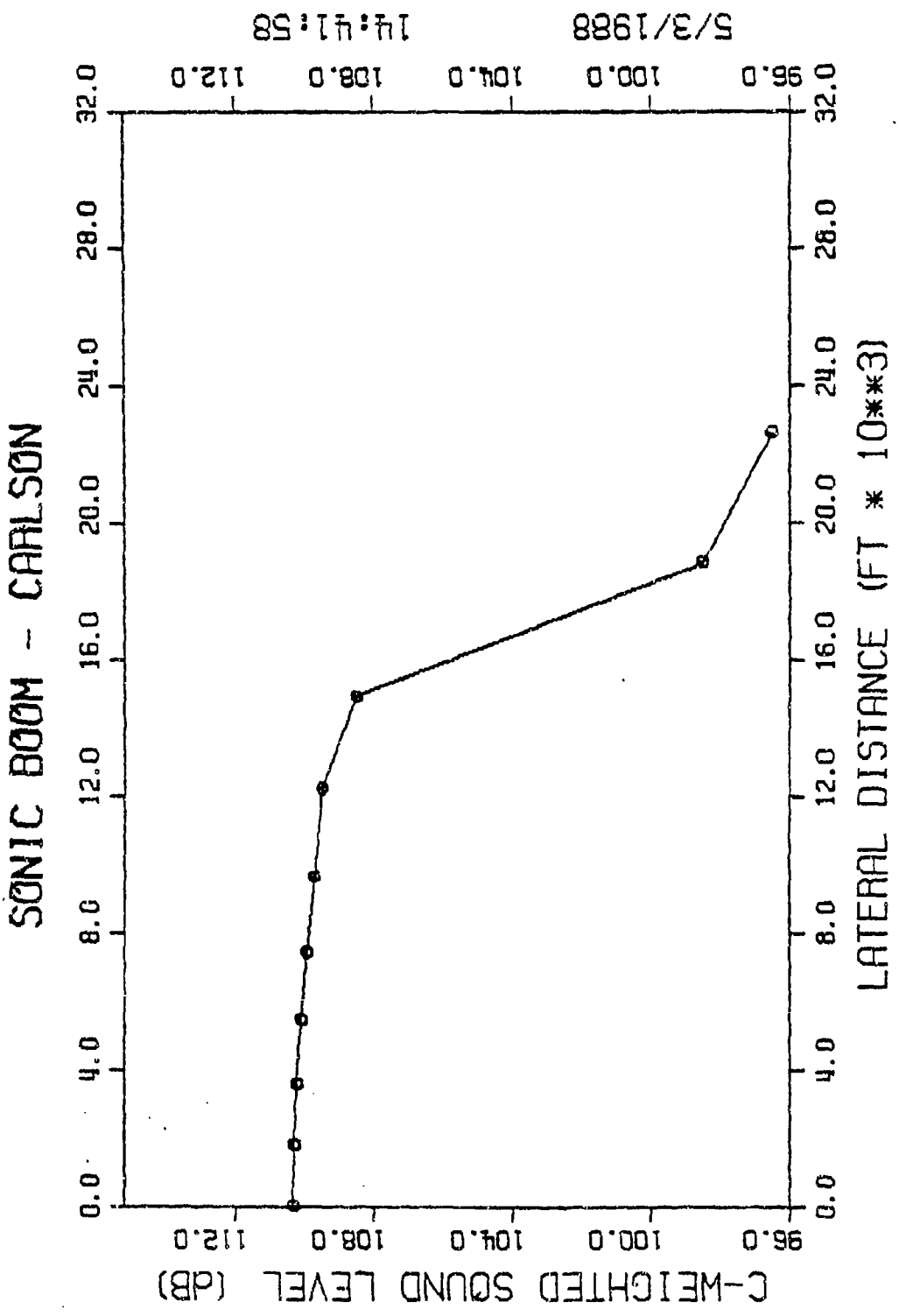


Figure 6. Tabular Overpressure versus Distance Data from Carlson's Method.

SONIC BOOM OVERPRESSURE RESULTS | F-15

MACH :	1.10	FLIGHT PT. :	1
LENGTH :	63.80(FT)	WEIGHT :	42.30(KLBS)
GROUND HEIGHT :	2000.00(FT)	ALTITUDE :	20000. (FT)
FLIGHT PATH ANGLE :	.00(DEG)	CUTOFF :	18838. (FT)

LATERAL DISTANCE	FORWARD DISTANCE	BOW SHOCK OVERPRESSURE	CSEL	SIGNATURE DURATION
.0	53298.5	2.73	110.33	.151
1772.8	53582.7	2.72	110.30	.151
3575.3	54452.0	2.70	110.22	.151
5442.4	55963.1	2.66	110.10	.152
7423.1	58241.3	2.61	109.93	.153
9602.6	61570.8	2.55	109.72	.155
12191.9	66783.6	2.48	109.48	.157
14910.7	72257.1	2.21	108.48	.159
18838.3	80164.0	.70	98.48	.159
22605.9	87749.0	.56	96.50	.159

Figure 7. Sample Footprint Plot.

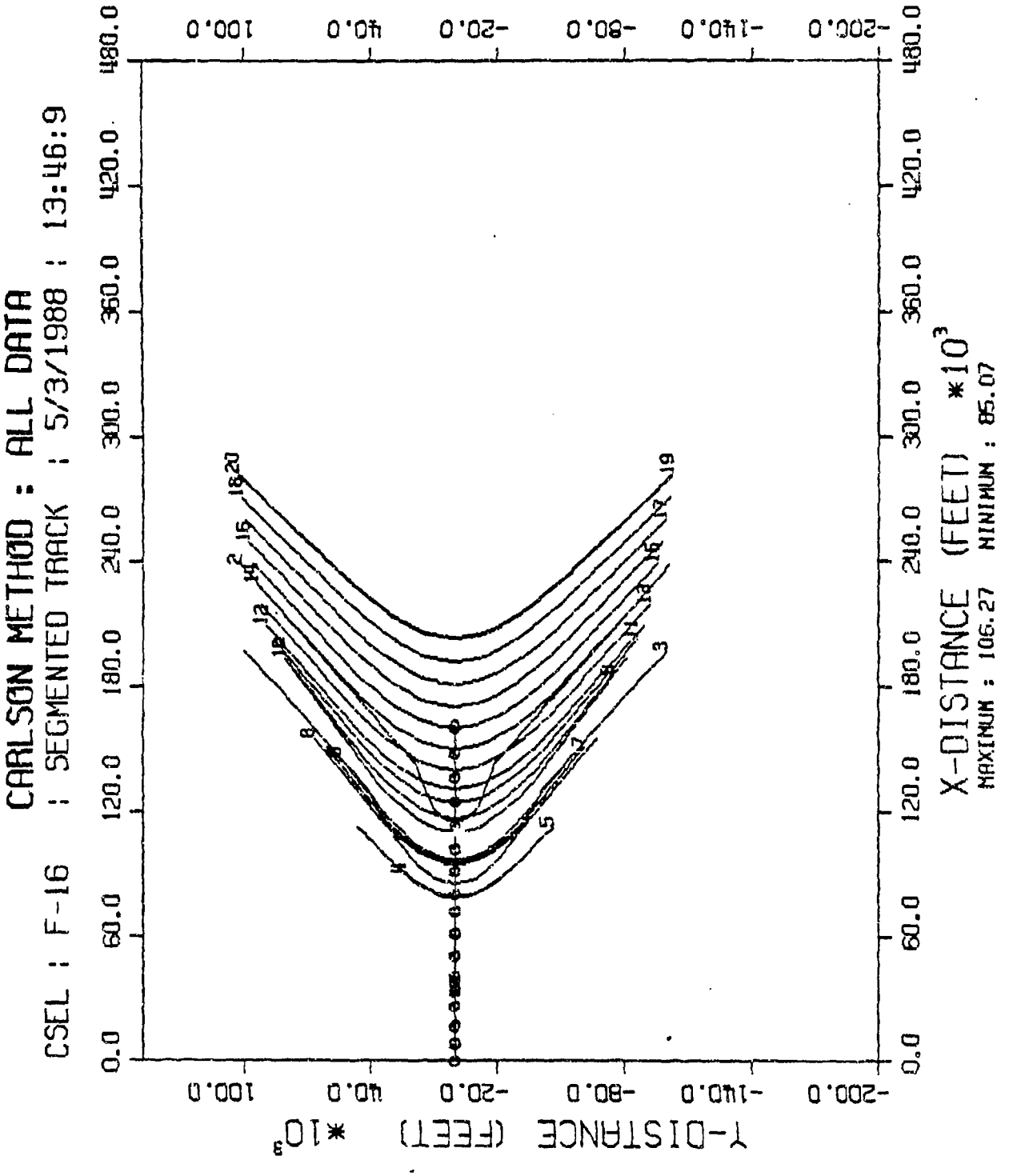


Table 5. PCBOOM — Errors

ERRORS	SOLUTIONS
1) Program too big to fit in memory	— Reboot the system with the minimum operating system. It may also be necessary to reduce the number of buffers in "CONFIG.SYS" to 10 and reboot.
2) Too many open files	— Increase the number of files in "CONFIG.SYS" to 20 and reboot.
3) Error #4 Unplottable Vectors	— Ignore. Axis vecors which are of no interest are outside the plotting window. The current version of PLOT88 cannot suppress this message.

REFERENCES

1. Carlson, H. W., "Simplified Sonic-Boom Prediction", NASA Technical Paper 1122, March 1978.

2. Bishop, D. E., Harber, J. M., Wilby, E. G., "BOOMAP2 Computer Program for Sonic Boom Research: Volume 1. Technical Report", BBN Report 6487, August 1987.

3. Day, P. J., Reilly, T. M., Seidman, H., "BOOMAP2 Computer Program for Sonic Boom Research: Volume 2 Program User/Computer Operational Manual", BBN Report 6488, August 1987.

4. Day, P. J., Reilly, T. M., Seidman, H., 'BOOMAP2 Computer Program for Sonic Boom Research: Volume 3. Program Maintenance Manual", BBN Report 6489, August 1987.

5. Wilby, E., Horonjeff, R., Bishop, D., "User's Guide to MOAOPS and BOOM-MAP Computer Programs for Sonic Boom Research", AMD-TR-86-005, January 1986.

6. "Microsoft FORTRAN Optimizing Compiler", Microsoft Corp., 1987.

7. "The SPINDRIFT Library", Spindrift Laboratories, 1987.

8. "PLOT88 Software Library Reference Manual", Plotworks, Inc., 1987.